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CIGARETTE MANUFACTURING MACHINE PRINTER

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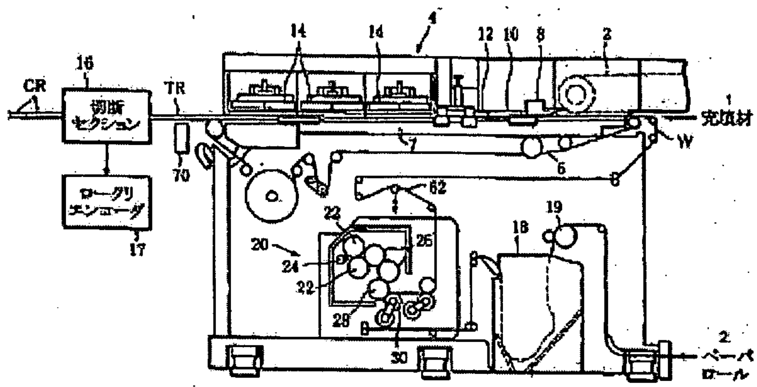

16...CUTTING SECTION
17...ROTARY ENCODER
1...FILLER
2...PAPER ROLL

(57) Abstract: A printer of a cigarette manufacturing machine has a concentration sensor (70) disposed between a wrapping section (4) and a cutting section (16) of the cigarette manufacturing machine. The concentration sensor (70) detects the concentration of printing information (PI) of a tobacco rod (TR). Printing information (PI) is printed on a paper web (W) by a printing unit (20) arranged on the upstream side of the wrapping section (4). An adjustment device (62) capable of varying the length of the feed passage of the paper web (W) is further disposed between the printing unit (20) and the wrapping section (4). A concentration signal from the concentration sensor (70) is used to control the operation of the printing unit (20) and the adjustment device (62). As a result, the concentration of printing information (PI) and the reaching timing at which printing information (PI) reaches the concentration sensor (70) are respectively controlled according to the concentration signal.

Technical field

This invention relates to a printer for printing desired informational items on a paper web used for manufacturing tobacco rods, that is, cigarette rods, with a cigarette manufacturing machine.

Prior art

A cigarette manufacturing printer is disclosed in Japanese Kokai Patent Application No. Hei 5[1993]-327938, for example. The printer in this publication includes a print unit and the print unit is placed in the paper web supply path. The paper web is supplied toward the wrapping section of the cigarette manufacturing machine along the supply path, and the print unit prints a desired informational item intermittently on the surface of the paper web with this process.

A fixed distance, that is, a length corresponding to two cigarette portions in a filter cigarette, is ensured between print informational items on the paper web. Each print informational item additionally includes a pair of marks, and these marks are spaced with a prescribed interval in the length direction of the paper web. Each mark can additionally include a number that indicates the cigarette manufacturing machine and a code or the like that indicates the plant where the cigarette manufacturing machine is installed.

Filler material, including shredded tobacco, is enclosed in the paper web in a process where the printed paper web passes through a wrapping section and a tobacco rod is formed. After this, the tobacco rod is sent from the wrapping section to a cutting section of the cigarette manufacturing machine, and it is cut into individual cigarette rods by the cutting section. Each cigarette rod has the abovementioned length and one print informational item. The print informational item is positioned in the center of the cigarette rod length.

Next, the cigarette rods manufactured with the cigarette manufacturing machine are supplied to a filter attachment machine for the so-called filter attachment. With the filter attachment, the cigarette rod is first cut between the pair of marks, becoming two cigarette portions, and each cigarette portion has 1 mark.

After this, a filter plug is attached between the two cigarette portions. Then the cigarettes and filter plug are formed into 1 double filter cigarette by wrapping with tube paper. More specifically, the tube paper is wrapped by enclosing the filter plug and the ends of the cigarette portions which are held contacting both ends of the filter plug. The filter plug will be connected to both cigarette portions and the mark on each cigarette portion will also be hidden.

The double filter cigarette is further cut through the tube paper in the center of the filter plug and individual filter cigarettes are obtained.

The marks on the cigarette portions described above are hidden by the tube paper, so a smoker will not smoke the filter cigarette to the position of the mark, and the mark will not be burned.

To reliably hide the mark on the cigarette portion with tube paper, the print informational items must be precisely printed on the paper web. However, if slippage occurs during travel of the paper web in the wrapping section of the cigarette manufacturing machine, the print informational item on a cigarette rod will be positioned away from the center of the cigarette rod.

Even when the cigarette rod is cut in filter attachment, the cutting will not be accurately accomplished between the pair of marks in the print informational item, and filter cigarettes with the mark exposed from the tube paper, or filter cigarettes without marks are manufactured. These filter cigarettes will be defective products.

Also, when an informational item is printed on the paper web, the print informational item, that is, the print density of the pair of marks, must also be correct. When the print density of the marks is dark or light, defective filter cigarettes will also be manufactured.

Disclosure of the invention

The objective of this invention is to provide a printer that can manage displacement of an informational item printed on the paper web and the print density using a common sensor, and that can appropriately control displacement of the print informational item and print density.

In order to accomplish the aforementioned objective, the printer of this invention includes: a print section that has a print roller disposed in the paper web supply path and an ink supply source that supplies ink toward the print roller, and it prints print informational items with the print roller on a paper web so as to provide a prescribed informational item for each cigarette rod; a density sensor that is disposed between the wrapping section and the cutting section and detects the density of each print informational item on the paper web; a density controller that controls the print density of the print informational item based on density signals from the density sensor; a calculation device that calculates the amount of temporal divergence between the time at which a print informational item provided for a tobacco rod should be detected at the density sensor and the actual time when the print informational item is detected by the density sensor, and outputs the calculated amount of divergence; and a timing controller that controls the timing for when the print informational item arrives at the density sensor to compensate for the amount of divergence determined by the calculation device.

With the abovementioned printer, while the density signals from the density sensor are used to control the density of the print informational item, they are also used to calculate the amount of temporal divergence between the time at which the print informational item should arrive at the density sensor and the actual detection time of the print informational item, that is, the time at which a density signal is output. Then, based on the amount of divergence calculated, the timing at which the print informational item arrives at the density sensor, that is, the displacement of the print informational item, is compensated. Therefore, the printer of this invention does not require a sensor specifically for calculating the amount of divergence.

Here, the abovementioned arrival time can be determined based on the tobacco rod cutting timing, the distance between the tobacco rod cutting position and the density sensor, and the tobacco rod delivery speed (feed speed of the paper web).

In concrete terms, the cigarette rod has an intended cutting position where it should be cut at the center in the direction of its axis. After the cigarette rod is supplied to the filter cigarette manufacturing machine, the cigarette rod is cut at the intended cutting position and formed into two cigarettes. In this case, the print informational item includes a pair of marks provided on the cigarette rod on either side of the intended cutting position.

The abovementioned density controller can also include an abnormality determination means that determines whether the density signal of each cigarette rod is in a suitable range and

outputs an exclude signal when the density signal is outside the suitable range, and a density adjustment means that calculates the average density of the print informational item based on the recorded density signals per prescribed number of cigarette rods and adjusts the amount of ink supplied from the ink supply means based on the average density calculated.

With such a density controller, cigarette rods where the print density is defective can be excluded individually based on the exclude signal, and defective cigarette rods will not be mixed with good quality cigarette rods.

The density controller can also output an operation stop signal for the cigarette manufacturing machine when the average density is at an abnormal level. Outputting such an operation stop signal prevents a large quantity of defective cigarette rods from being produced.

In concrete terms, the abovementioned ink supply means includes an ink spray that sprays ink. The density controller can vary at least the ink spray time or spray interval.

The amount of ink discharged from the ink spray can be controlled very precisely according to the cigarette rod manufacturing speed and the density of the print informational item can be kept appropriate regardless of the operating speed of the cigarette manufacturing machine.

On the other hand, the timing controller can include an abnormality determination means that determines whether the amount of divergence of each cigarette rod is in an appropriate range and that outputs an exclude signal when the amount of divergence is not in the appropriate range, and a path length adjustment means that calculates the average amount of divergence of the print informational item based on the amount of divergence per a prescribed number of cigarette rods and adjusts the length of the supply path from the printing section to the wrapping section based on the average amount of divergence calculated.

With such a timing controller, cigarette rods where the position of the print informational item is wrong can be excluded individually and defective cigarette rods will not be mixed with good quality cigarette rods.

The timing controller can also output an operation stop signal for the cigarette manufacturing machine when the average amount of divergence is at an abnormal level. Therefore, a large quantity of defective cigarette rods will not be produced.

For example, the path length adjustment means can include a guide roller that is placed in the supply path between the printing section and the wrapping section and that guides the travel of the paper web, a roller carrier that rotatably supports the guide roller and that can be displaced in a direction perpendicular to the supply path, and a drive source that displaces the roller carrier. In concrete terms, the roller carrier is a turning arm that has a guide roller at its tip, and the base end of the turning arm is rotatably supported.

The path length adjustment means speeds up or slows down the timing at which the print informational item arrives at the density sensor as the guide roller moves, and the amount of divergence is compensated by this.

Brief description of the figures

Figure 1 is a schematic diagram that shows a part of a cigarette manufacturing machine;

Figure 2 is a side view of a cigarette rod manufactured with the cigarette manufacturing machine in Figure 1;

Figure 3 shows the print unit and the area around it;

Figure 4 shows the adjusting device that adjusts the length of the paper web supply path between the print unit and the wrapping section;

Figure 5 is a plan view of the density sensor;

Figure 6 shows the controller that controls the operation of the ink spray and adjustment device based on signals from the density sensor and a rotary encoder;

Figure 7 is a control block diagram for controlling the print density of the printing informational item, in the controller in Figure 6;

Figure 8 is a flow chart that shows the print density control routine;

Figure 9 is a control block diagram for controlling print informational item displacement, that is, arrival timing, in the controller in Figure 6; and

Figure 10 is a flow chart that shows the arrival timing control routine.

Preferred embodiment of the invention

Figure 1 schematically shows a part of a cigarette manufacturing machine.

The cigarette manufacturing machine is provided with an endless tobacco belt (2). Tobacco belt (2) is disposed at the right end as seen in Figure 1. Filler material is attached in the form of layers on the undersurface of tobacco belt (2), and the filler material includes shredded tobacco. The filler material attached onto tobacco belt (2) is supplied to wrapping section (4) as tobacco belt (2) travels. A paper web (W) is supplied to wrapping section (4), and filler material from tobacco belt (2) is received on paper web (W).

The filler material passes through wrapping section (4) along with the paper web (W). In this case, the filler material is enclosed in paper web (W) so that a tobacco rod (TR) is formed continuously.

More specifically, wrapping section (4) is provided with endless garniture tape (6). A horizontal portion of garniture tape (6) extends through wrapping section (4) and sends paper web (W) in one direction along with the filler material.

Wrapping section (4) includes molding bed (7) that guides the horizontal portion of garniture tape (6). Tongue (8), short holder (10), and long holder (12) are disposed in order from the belt (2) end on molding bed (7). Tongue (8) is provided with a shoe, and the shoe works as a scraper to remove filler material from belt (2). Therefore, filler shreds are supplied from belt (2) to paper web (W). After this, tongue (8) compresses and molds the filler material into a cylindrical shape in conjunction with molding bed (7) and garniture tape (6). In this case, paper web (W) is molded in a U shape. Then short holder (10) molds one side edge of paper web (W) along the cylindrical filler material, long holder (12) molds the other side edge of paper web (W) along the cylindrical filler material, they are overlapped at one side edge, and in this way, the cylindrical filler material is wrapped with paper web (W).

Before the other side edge of paper web (W) is molded, the other side edge is coated with glue. Therefore, when the two side edges of paper web (W) are overlapped, the two side edges are adhered and a slimline tobacco rod (TR) is formed.

After this, tobacco rod (TR) passes through multiple heaters (14) in order. These heaters (14) are disposed downstream from long holder (12). Heaters (14) dry the seam line of tobacco rod (TR).

Tobacco rods (TR) that have been dried are sent from wrapping section (4) and then pass through cutting section (16). Cutting section (16) cuts the tobacco rod (TR) of a prescribed length after [sic], and forms a cigarette rod (CR). A cigarette rod (CR) has twice the length of a cigarette in a filter cigarette.

More specifically, cutting section (16) includes a rotary knife (not shown), and the rotary knife has a rotary disk and multiple cutter blades attached at equal intervals around the outside periphery of the rotary disk. The rotary knife rotates at a peripheral speed corresponding to the travel speed of paper web (W) and cuts the tobacco rod (TR) into individual cigarette rods (CR).

Cutting section (16) additionally includes a rotary encoder (17). Rotary encoder (17) detects the angle of rotation of the rotary knife and outputs a detection signal.

At the same time, paper web (P) [sic; (W)] follows a prescribed supply path from a web roll (not shown) and is directed to garniture tape (6) of wrapping section (4). Web reservoir (18), feed roller (19), and print unit (20) are disposed in order from the web roll side in the supply path. Feed roller (19) pays out paper web (W) from the web roll at a speed that corresponds to the travel speed of garniture tape (6). Note that the web roll has been given a prescribed braking power.

Print unit (20) includes ink sprayer (24) and a pair of inlet rollers (22). The inlet rollers (22) rotate against each other and accept ink sprayed from ink sprayer (24). Print roller (28) revolvingly contacts one inlet roller (22) via a pair of transfer rollers (26), and the abovementioned paper web (W) passes between print roller (28) and press roller (30).

The ink accepted on the pair of inlet rollers (22) is supplied to print roller (28) by the pair of transfer rollers (26), and then print roller (28) prints the desired informational item intermittently on paper web (W). In concrete terms, informational items are printed on paper web (W) at a spacing equivalent to abovementioned cigarette rods (CR). Therefore, cigarette rods (CR) have one printed informational item each, and the printed informational item is positioned in the center of the cigarette rod (CR) length and is positioned on the opposite side from the abovementioned seam line of the cigarette rod (CR) diameter.

As shown in Figure 2, print informational item (PI) includes a pair of marks (M). A prescribed spacing is ensured in the length direction of paper web (W), that is, cigarette rod (CR), between the marks (M), and between each mark (M) and the corresponding end surface of cigarette rod (CR) is equal. Note that each mark (M) includes a number that indicates the cigarette manufacturing machine and a code number that indicates the plant number where the cigarette manufacturing machine is installed.

Figure 3 concretely shows ink sprayer (24) and the ink and compressed air supply system for ink sprayer (24).

Ink sprayer (24) contains nozzle (34) at its tip, and this nozzle (34) has spray opening (32). Spray opening (32) is opened in the direction between the abovementioned pair of inlet rollers (22). Ink sprayer (24) also includes a valve needle (not shown), and the valve needle is driven by a solenoid and opens and closes spray opening (32) of nozzle (34).

Ink sprayer (24) has in addition two ports (36) and (38) on its outside surface. Ink supply tube (40) and air supply duct (42) extend from ports (36) and (38), respectively. Ink supply duct (40) is connected to ink tank (46), and blue ink is stored in ink tank (46). A variable diaphragm (44) is placed in ink supply duct (40).

Pressurized duct (48) extends from the top part of ink tank (46), and pressurized duct (48) is connected to compressed air source (50). Regulator (52) and opening and closing valve (54) are placed in order from compressed air source (50) in pressurized duct (48). When opening/closing valve (54) is open, compressed air source (50) supplies compressed air into ink tank (46) through pressurized duct (48), and the pressure of the compressed air is regulated by regulator (52). Therefore, the ink inside ink tank (46) will be pressurized by the compressed air.

Air supply duct (42) is connected to compressed air source (56). Regulator (58) and solenoid valve (60) are placed in order from compressed air source (56) in air supply duct (42). Solenoid valve (60) is a three port, two position direction control valve and is switched between a supply position that supplies compressed air to ink sprayer (24) and a discharge position that discharges compressed air from ink sprayer (24). Therefore, when solenoid valve (60) is switched to the supply position, compressed air is supplied to ink sprayer (24) through air supply duct (42)

from compressed air source (56) and the pressure of the compressed air is regulated by regulator (58).

In a state where the supply of pressurized ink and compressed air to ink sprayer (24) are both allowed, when spray opening (32) of nozzle (34) is open, ink is discharged along with compressed air from spray opening (32), and therefore, ink is supplied between the pair of inlet rollers (22) in the form of a spray.

More specifically, spray opening (32) of nozzle (34) is opened and closed by valve needle driving as described above, and the valve needle is driven by a solenoid. Therefore, when a drive signal is supplied to the solenoid of the valve needle as a pulse, ink is intermittently sprayed from spray opening (32). Therefore, the amount of ink discharged is determined by the drive signal output time (ink spray time) and the drive signal output interval (ink spray interval).

Here, the basic spray time and basic spray interval are each determined according to the amount of ink consumed, that is, the manufacturing speed of cigarette rods (CR). The manufacturing speed of cigarette rods (CR), in other words, the speed of rotation of the rotary knife in the abovementioned cutting section (16), is calculated from the tobacco rod (TR) delivery speed.

Referring to Figure 1 again, an adjustment device (62) is placed in the supply path of paper web (W). Adjustment device (62) is disposed between print unit (20) and wrapping section (4) and varies the length of the travel path for paper web (W) from print unit (20) up to wrapping section (4).

As shown in Figure 4, adjustment device (62) includes a guide roller (64), and guide roller (64) guides the travel of paper web (W). Guide roller (64) is rotatably supported at the tip of control arm (66), and the base end of control arm (66) is attached to the output shaft of step motor (68). Step motor (68) turns control arm (66) in the forward direction (clockwise) or in the opposite direction (counterclockwise) as viewed in Figure 4. The turning of control arm (66) displaces guide roller (64) in a direction perpendicular to the direction of travel by paper web (W), and along with this, the length of the abovementioned travel path of paper web (W) changes. In concrete terms, when control arm (66) is turned in the forward direction as shown in Figure 4, the length of the travel path is increased. In contrast to this, when control arm (66) is turned in the opposite direction, the length of the travel path is reduced.

In addition, as shown in Figure 1, photographic density sensor (70) is disposed between wrapping section (4) and cutting section (16), and density sensor (70) is positioned directly beneath the delivery path of tobacco rod (TR). Density sensor (70) detects the print informational item (PI) on tobacco rod (TR), that is, the wrapping paper (paper web (W)) and outputs a detection

signal. Here, the detection signal from density sensor (70) indicates the print density of the print informational item (PI), that is, the pair of marks (M).

In concrete terms, density sensor (70), as shown in Figure 5, has sensing window (72) facing toward tobacco rod (TR), and an infrared beam is applied toward tobacco rod (TR) through sensing window (72). The infrared beam reflected by tobacco rod (TR) is received at density sensor (70) through sensing window (72) and density sensor (70) outputs a density signal that indicates the intensity level of the infrared beam received, that is, the print density of print informational item (PI).

Print informational item, as described above, is printed with blue ink, so the infrared beam has a complementary color relationship to the blue color of print informational item (PI). Therefore, density sensor (70) can effectively receive the infrared beam reflected from mark (M) and the density signal accurately indicates the print density of print informational item (PI).

As shown in Figure 6, the abovementioned rotary encoder (17) and density sensor (70) are electrically connected to input equipment (76), such as a keyboard, as well as to the input side of controller (74). Solenoid driver (78), motor driver (80) and display device (82) are each electrically connected to the output side of controller (74). Solenoid driver (78) is connected to ink sprayer (24), that is, to the solenoid of the valve needle, and motor driver (80) is connected to step motor (68).

Controller (74) determines the print density of print informational item (PI) from the density signal from density sensor (70) and whether the timing of arrival of print informational item (PI) at density sensor (70) is appropriate. Then it adjusts the print density of print informational item (PI) and the arrival timing based on the determination results.

The management functions of abovementioned controller (74) are concretized by the control block diagram and control routine shown in Figures 7-10. This control block and control routine will be explained in detail below.

The control block diagram in Figure 7 shows control of the print density of mark (M).

First, a density signal from density sensor (70) is supplied to amplifier (84), amplifier (84) amplifies the density signal, and the amplified density signal is supplied to integrator (86). Integrator (86) integrates the amplified density signal and the integrated density signal is supplied to next sampling circuit (88). Sampling circuit (88) is opened or closed based on synchronous signal (S_S) and supplies the density signal for one print informational item (PI) to latch circuit (90). Latch circuit (90) A/D converts the density signal from sampling circuit (88) and supplies the conversion result to next comparator (96) while it is temporarily held.

On the other hand, the density signal from sampling circuit (88) is supplied to adjustment circuit (92). Adjustment circuit (92) adjusts the threshold value based on that density signal and supplies the adjusted threshold value to comparator (94).

Comparator (94) receives the density signal from amplifier (84) along with the comparison threshold value, compares the density signal and threshold value, and outputs the result of comparison. More specifically, comparator (94) outputs a mark signal (S_M) only when the density signal is at or above the threshold value. Hence when the print informational item (PI) on tobacco rod (TR), that is, a pair each of marks (M), is printed normally, comparator (94) outputs two mark signals (S_M) for each print informational item (PI).

At the same time, an upper limit value and lower limit value are supplied from CPU board (98) to abovementioned comparator (96). When comparator (96) receives a density signal supplied from latch circuit (90), it compares the density signal supplied with the upper limit value and lower limit value and supplies the comparison result to CPU board (98).

In concrete terms, when the density signal is at or below the light lower limit value or at or above the dark upper limit value, comparator (96) outputs an abnormal value as the density value. In contrast to this, when the density signal is greater than the lower limit value and smaller than the upper limit value, the density signal is output unchanged. CPU board (98) also displays the density corresponding to the density value received on display device (82).

CPU board (98) is a microcomputer that includes a CPU, memory, peripheral equipment and an input/output interface. CPU board (98) determines whether the density signal from comparator (96), that is, the print density of print informational item (PI), is in the appropriate range. Based on the determination results, if necessary, CPU board (98) corrects the drive signal to be supplied to the solenoid of ink sprayer (24) through solenoid driver (78). The result is the that print informational item (PI), that is, the density of mark (M), is adjusted.

Figure 8 shows the control routine executed by CPU board (98) to adjust the density of print informational item (PI).

In this control routine, first, the density signal for print informational item (PI) from comparator (96) is read (step S1). Then whether or not the density signal that was read is an abnormal value is determineed (step S2). Here when the determineed result is true (yes), an exclude signal is output from CPU board (98) (step S3). In contrast, when the determineed result from step S2 is false (no), step S3 is bypassed and following step S4 is executed.

When an exclude signal is output, the cigarette rod (CR) that has print informational item (PI) with an abnormal print density is excluded in the process wherein it is sent to filter attachment from the cigarette manufacturing machine, or in the abovementioned filter attachment.

On the other hand, at step S4, whether or not reading of the density signal has reached a prescribed number of times (X) is determineed. When the determineed result here is false, the steps in steps S1-S4 are repeatedly carried out.

When the determineed result of step S4 is true, the average value (A) of the density signal for X times is calculated (step S5), and then it whether or not average density (A) is at an abnormal level is determineed (step S6).

Here, a situation where the determineed result of step S6 is true means that there are many abnormal values among the density signals that were read and that an exclude signal has been output frequently. Therefore, in such a situation, it is determined that there is an error in the setting for the basic spray time and/or the basic spray interval in ink sprayer (24), and CPU board (98) will output an operation stop signal and stop the operation of the cigarette manufacturing machine (step S7).

When the determineed result at step S6 is false, it is determineed sequentially whether or not average density (A) shows a light tendency (step S8) and whether or not average density (A) shows a dark tendency (step S9). In concrete terms, at steps S8 and S9, average density (A) and the target density range are compared. When average density (A) is smaller than the target density range, the determineed result at step S8 will be true. In contrast, when average density (A) is larger than the target density range, the determineed result at step S9 will be true.

When the determineed result at step S8 is true, that is, when the print density of print informational item (PI) is lighter than the target density range, darkness increment ΔD, as a control value to make the density of print informational item (PI) darker, is calculated (step S10). In concrete terms, darkness increment ΔD is obtained based on the deviation between average density (A) and the target density range (that is the lower limit value of the target density range).

On the other hand, when the determineed result at step S8 is false, but the determineed result at step S9 is true, that is, when the print density of print informational item (PI) is darker than the target density range, lightness increment ΔL, as a control value to make the density of print informational item (PI) lighter, is calculated (step S11). Here, lightness increment ΔL is obtained based on the deviation between average density (A) and the target density range (that is the upper limit value of the target density range).

When darkness increment ΔD or lightness increment ΔL is calculated in this way, the drive signal for the abovementioned solenoid is changed based on the darkness increment ΔD or lightness increment ΔL (step S12).

In concrete terms, at step S12, the output time and/or output interval of the drive signal is changed. Therefore, the ink spray time and/or spray interval is corrected, and the amount of ink discharged from ink sprayer (24) is increased or decreased. The result is that the density of the

print informational item (PI) printed on paper web (W) by abovementioned print unit (20) will be darker or lighter and is kept in the target density range.

The basic spray time and basic spray interval for the ink as described above are set based on the delivery speed of tobacco rod (TR), so the control routine can optimally adjust the print density of print informational item (PI) without affecting the delivery speed of tobacco rod (TR) (manufacturing speed by the cigarette manufacturing machine).

The control routine in Figure 8 can include a subroutine for manual adjustment. In that case, the operator can adjust the amount of ink discharged from ink sprayer (24) based on the display results for density on display device (82).

Figure 9 shows a control block for detecting and adjusting the arrival timing of print informational item (PI)

As shown in Figure 9, the abovementioned rotary encoder (17) is electrically connected to a signal generating circuit (100) and signal generating circuit (100) can accept a rotation angle signal for the rotary knife from rotary encoder (17). Signal generating circuit (100) outputs an arrival signal (S_P) each time that print informational item (PI) on tobacco rod (TR) arrives at sensing window (72) of density sensor (70) based on the rotation angle signal received. More specifically, arrival signal (S_P) is output at the timing when the front mark (M), of the pair of marks (M) included in print informational item (PI), arrives at sensing window (72).

For this reason, signal generating circuit (100) recognizes in advance the rotation angle of the rotary knife corresponding to the output timing of arrival signal (S_P), based on the delivery speed of tobacco rod (TR), the rotation angle of the rotary knife, which indicates the cutting timing of tobacco rod (TR), and the distance between the cutting position on tobacco rod (TR) and sensing window (72) of density sensor (70).

Arrival signal (S_P) is supplied to sensing period generating circuit (102) along with a the rotation angle signal from rotary encoder (17). Sensing period generating circuit (102) outputs abovementioned synchronous signal (S_S) at the point where arrival signal (S_P) is received, and the output of this is continued until print informational item (PI) has passed sensing window (72) of density sensor (70).

That is, sensing period generating circuit (102) recognizes in advance the rotation angle of the rotary knife corresponding to the output end timing of synchronous signal (S_S) based on the length of print informational item (PI) in the direction of delivery of tobacco rod (TR), that is, the length from the front edge of front mark (M) to the back edge of the back mark (equivalent to sensing period), and the delivery speed of the tobacco rod (TR). This is because the output end timing of synchronous signal (S_S) is determined by the rotary angle signal from rotary encoder (17).

The abovementioned synchronous signal (S_S) is supplied to sampling circuit (88) (Figure 7) and is also supplied to both abovementioned mark signal (S_M) judgment circuit (104) and counter (106).

Judgment circuit (104) receives synchronous signal (S_S) and mark signal (S_M) and counts the number of mark signals (S_M) in the sensing section for print informational item (PI). Here, when the count results for mark signal (S_M) is not 2, judgment circuit (104) judges that an abnormality has occurred in the printing of print informational item (PI) (that is, the pair of marks (M)). In this case, judgment circuit (104) supplies an abnormality signal to CPU board (98). When it receives such an abnormality signal, CPU board (98) outputs an exclude signal.

At the same time, mark signal (S_M) and arrival signal (S_P) are also supplied to both first sensing circuit (108) and advance angle/lag angle sensing circuit (110), and the rotation angle signal from rotary encoder (17) is also supplied to first sensing circuit (108).

First sensing circuit (108) senses the time difference between the point when mark signal (S_M) is received and the point when arrival signal (S_P) is received based on the rotation angle signal from rotary encoder (17). The time difference here indicates the amount of divergence ΔD of the arrival timing for print informational item (PI) of cigarette rod (CR) per 1 unit. The amount of divergence ΔD is supplied from first sensing circuit (108) to judgment circuit (112), and judgment circuit (112) judges whether the amount of divergence ΔD is in a normal range.

In concrete terms, upper and lower abnormal threshold values are supplied to judgment circuit (112) from CPU board (98) and those abnormal threshold values specify the normal range for the amount of divergence ΔD. Therefore, judgment circuit (112) compares the abnormal threshold values and the amount of divergence ΔD in arrival timing from first sensing circuit (108). When the amount of divergence ΔD is outside the normal range, judgment circuit (112) outputs an exclude signal to CPU board (98).

At the same time, advance angle/delay angle sensing circuit (110) senses whether the point when mark signal (S_M) is early or late relative to the point when arrival signal (S_P) was received and supplies the sensing result to second sensing circuit (114). The amount of divergence ΔD in arrival timing from first sensing circuit (108) is also supplied to second sensing circuit (104).

The abovementioned counter (106) counts the number of cigarette rods (CR) that pass density sensor (70) up to N based on synchronous signal (S_S) and the rotation angle signal from rotary encoder (17). When the number of cigarette rods (CR) that have passed reaches N, counter (106) supplies a reset signal to second sensing circuit (114) and counting of cigarette rods (CR) is repeated.

Second sensing circuit (114) adds the amount of divergence ΔD supplied from first sensing circuit (108), and this addition is continued until a reset signal from counter (106) is received.

When a reset signal is received, second sensing circuit (114) divides the total value by N and calculates the average amount of divergence ΔAD of the arrival timing for print informational item (PI). The calculation result is supplied to judgment circuit (116) along with the judgment result from advance angle/lag angle sensing circuit (110), that is, advance angle or lag angle informational item for mark signal (S_M). Judgment circuit (116) judges whether the average amount of divergence ΔAD is in a permissible range.

In concrete terms, upper and lower permissible threshold values for the average amount of divergence ΔAD are supplied to judgment circuit (116) from CPU board (98), and these permissible threshold values specify the permissible range for the average amount of divergence ΔAD.

Judgment circuit (116) judges the average amount of divergence ΔAD based on the permissible threshold values and supplies the judgment result to CPU board (98). Here, the judgment result includes a normal level where the arrival timing of print informational item (PI) is in the target zone within the permissible range, an advance angle level that indicates that the angle is ahead of the target zone, a lag angle level that indicates that it is behind the target zone, and also an abnormal level where the arrival time is significantly outside the permissible range.

CPU board (98) supplies a drive signal to step motor (68) of the abovementioned adjusting device (62) through motor driver (80) based on the judgment result from judgment circuit (116) and controls the arrival timing of print informational item (PI).

Figure 10 shows the control routine for arrival timing executed by judgment circuits (112) and (116) and CPU board (98).

With this routine, first, the amount of divergence ΔD in the abovementioned arrival timing is read (step S13), and then whether or not the amount of divergence ΔD is abnormal is determineed (step S14). When the determineed result here is true, CPU board (98) outputs an exclude signal to exclude the cigarette rod (CR) where the position of print informational item (PI) is abnormal (step S15). In contrast, when the determineed result is false, step S15 is bypassed and the next step S16 is executed.

At step S16, the judgment result from judgment circuit (116) is read, and then whether the judgment result is any of the abovementioned abnormal level, advance angle level, or lag angle level is determineed in sequence (steps S17, S18 and S19).

Here, when the judgment result is the advance angle level, that is, when the determineed result at step S18 is true, CPU board (98) outputs a forward direction drive signal to step motor (68) through motor driver (80) for a prescribed number of pulses (step S20). In this case, step motor (68) turns control arm (66) (guide roller (64)) of adjustment device (62) at a prescribed turning angle in the forward direction, and along with that, the supply path, that is, the travel path,

of paper web (W) between print unit (20) and wrapping section (4) becomes longer. The result is that the arrival timing by print informational item (PI) at cigarette rod (CR) is changed toward the proper position.

Note that as control arm (66) turns in the forward direction, paper web (W) slips against print roller (28), press roller (30) and the guide rollers downstream from control arm (66) and is excessively paid out. This excess payout is absorbed by accumulating paper web (W) in reservoir (18).

On the other hand, when the judgment result is the lag angle level (the determineed result at step S19 is true), CPU board (98) outputs a reverse direction drive signal to step motor (68) through motor driver (80) for a prescribed number of pulses (step S21). In this case, step motor (68) turns control arm (66) backward at a prescribed turning angle, and along with this, the travel path of paper web (W) will become shorter. In this case, too, the arrival timing of print informational item (PI) is changed toward the proper position in the same way.

Note that when the judgment result is the abnormal level (when the determineed result at step S17 is true), CPU board (98) stops operation of the cigarette manufacturing machine (step S22).

With the abovementioned arrival timing control routine, density sensor (70) is also used for sensing the arrival timing of print informational item (PI). So a sensor specifically for sensing arrival timing divergence is not required.

CPU board (98) outputs an exclude signal each time that a cigarette rod (CR) is detected where the arrival timing of print informational item (PI) is abnormal, so defective cigarette rods (CR) are reliably excluded. The result is that defective cigarette rods (CR) will not be mixed with good quality cigarette rods (CR).

When the average amount of divergence ΔAD in arrival timing is outside the target zone, CPU board (98) rotates step motor (68) of adjustment device (62) forward or backward and varies the travel path length of paper web (W) between print unit (20) and wrapping section (4). The result is that the arrival timing of print informational item (PI) is corrected toward the target zone.

Note that, for executing correction control for the arrival timing of print informational item (PI), the number of pulses of the drive signal supplied from CPU board (98) to step motor (68) through motor driver (80) at step S18 or S19 can be changed according to the magnitude of the average amount of displacement ΔAD.

This invention is not restricted to the abovementioned application example and many variations of this invention are possible.

For example, adjustment device (62) can use a slider equipped with a guide roller (64) in place of control arm (66). This slider will move rectilinearly in a direction perpendicular to the supply path of paper web (W).

Claims

1. A cigarette manufacturing machine printer, the aforementioned cigarette manufacturing machine includes a wrapping section that receives a paper web supplied along a supply path at a prescribed speed along with filler material, that molds tobacco rods with the aforementioned filler material wrapped in the aforementioned paper web, and that delivers the molded tobacco rod continuously, and a cutting section where the aforementioned tobacco rod delivered from the aforementioned wrapping section is cut at a prescribed cutting timing and cigarette rods of a prescribed length are formed;

the aforementioned printer includes:

a print section that has a print roller disposed in the aforementioned supply path and an ink supply source that supplies ink toward the aforementioned ink roller, and that prints prescribed informational items via the aforementioned print roller on the aforementioned paper web to provide an aforementioned print informational item to each of the aforementioned cigarette rods,

a density sensor that is disposed between the aforementioned wrapping section and the aforementioned cutting section, that senses the density of each print informational item on the aforementioned paper web, and outputs a density signal,

a density controller that controls the print density of the aforementioned print informational item based on the aforementioned density signal from the aforementioned density sensor,

a calculation device that calculates the amount of temporal divergence between the arrival time when the aforementioned print informational item provided on the aforementioned tobacco rod should arrive at the aforementioned density sensor and the actual detection time of the aforementioned print informational item by the aforementioned density sensor and that outputs the calculated amount of divergence,

and a timing control device that controls the timing at which the aforementioned print informational item arrives at the aforementioned density sensor to compensate for the aforementioned amount of divergence from the aforementioned calculation device.

2. In the printer in Claim 1,

the aforementioned cigarette rod has an intended cutting position at the center in the direction of its axis where it should be cut, and after the aforementioned cigarette rod is supplied to

a filter cigarette manufacturing machine, the aforementioned cigarette rod is cut at the aforementioned intended cutting position and formed into two cigarettes,

and the aforementioned print informational item includes a pair of marks added on either side of the aforementioned intended cutting position on the aforementioned cigarette rod.

3. In the printer in Claim 2,

the aforementioned density controller includes

an abnormality judgment means that judges whether the aforementioned print density signal for each cigarette rod is in the appropriate range and that outputs an exclude signal when the aforementioned density signal is outside the aforementioned appropriate range,

and a density adjustment means that calculates the average density of the aforementioned print informational item based on the aforementioned density signal for a prescribed number of cigarette rods and adjusts the amount of ink supplied from the aforementioned ink supply means based on the calculated average density.

4. In the printer in Claim 3,

the aforementioned density controller outputs an operation stop signal for the aforementioned cigarette manufacturing machine when the aforementioned average density is at an abnormal level.

5. In the printer in Claim 3,

the aforementioned ink supply means includes an ink spray that sprays ink,

and the aforementioned density controller varies at least the ink spray time or spray interval.

6. In the printer in Claim 2,

the aforementioned timing controller includes

an abnormality judgment means that judges whether the aforementioned amount of divergence of each cigarette rod is in an appropriate range and that outputs an exclude signal when the aforementioned amount of divergence is outside the aforementioned appropriate range,

and a path length adjustment means that calculates the average amount of divergence of the aforementioned print informational item based on the aforementioned amount of divergence for a prescribed number of cigarette rods and that adjusts the length of the aforementioned supply path from the aforementioned print section to the aforementioned wrapping section based on the calculated average amount of divergence.

7. In the printer in Claim 6,

the aforementioned timing controller outputs an operation stop signal for the aforementioned cigarette manufacturing machine when the aforementioned average amount of divergence is at an abnormal level.

8. In the printer in Claim 6,

the aforementioned path length adjustment means includes

a guide roller that is placed in the aforementioned supply path between the aforementioned print section and the aforementioned wrapping section and that guides the travel of the aforementioned paper web,

a roller carrier that rotatably supports the aforementioned guide roller and that can be displaced in a direction perpendicular to the aforementioned supply path,

and a drive source that displaces the aforementioned roller carrier.

9. In the printer in Claim 8,

the aforementioned roller carrier is a turning arm that has a guide roller at its tip and the base end of the turning arm is rotatably supported.

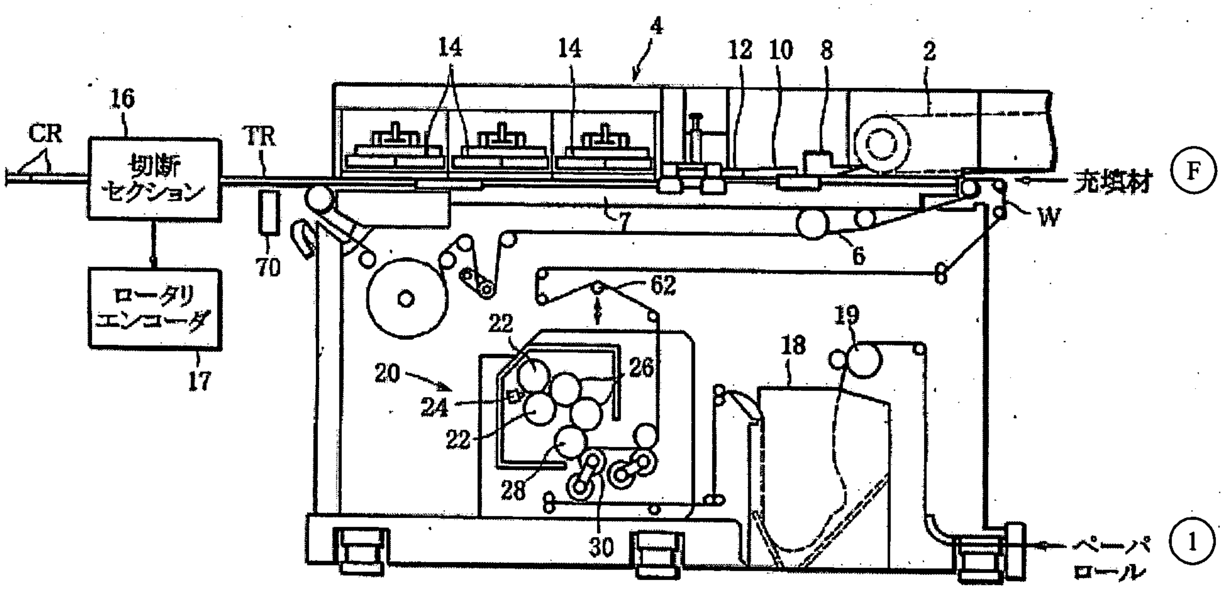

Figure 1

Key: F Filler material
1 Paper roll
16 Cutting section
17 Rotary encoder

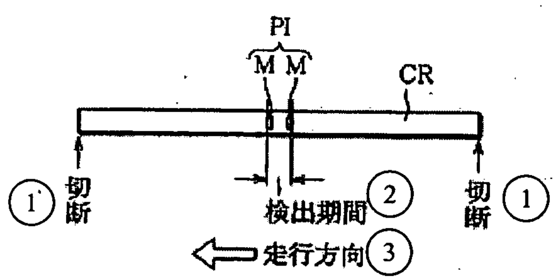

Figure 2

Key: 1 Cutting
2 Sensing period
3 Travel direction

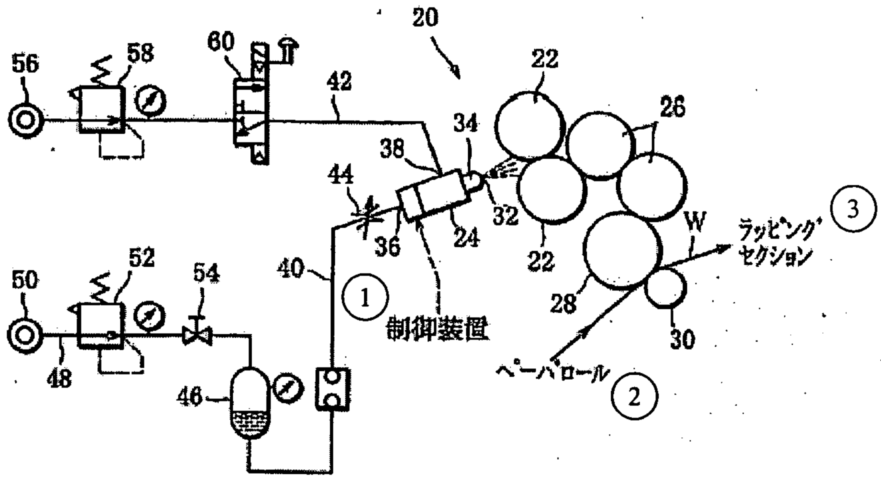

Figure 3

Key: 1 Controller
2 Paper roll
3 Wrapping section

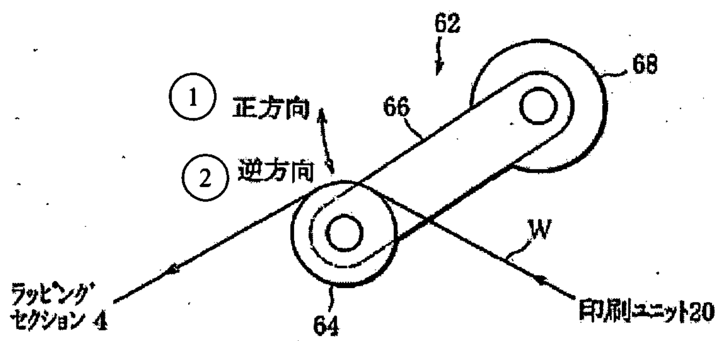

Figure 4

Key: 1 Forward direction
2 Reverse direction
4 Wrapping section
20 Print unit

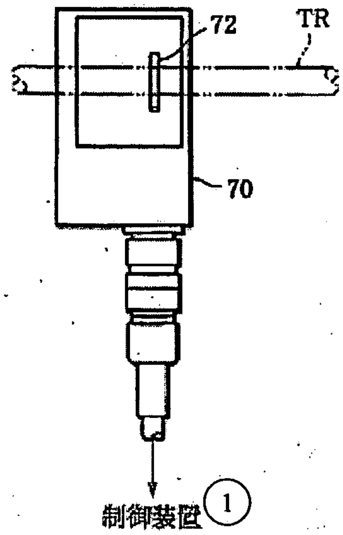

Figure 5

Key: 1 Controller

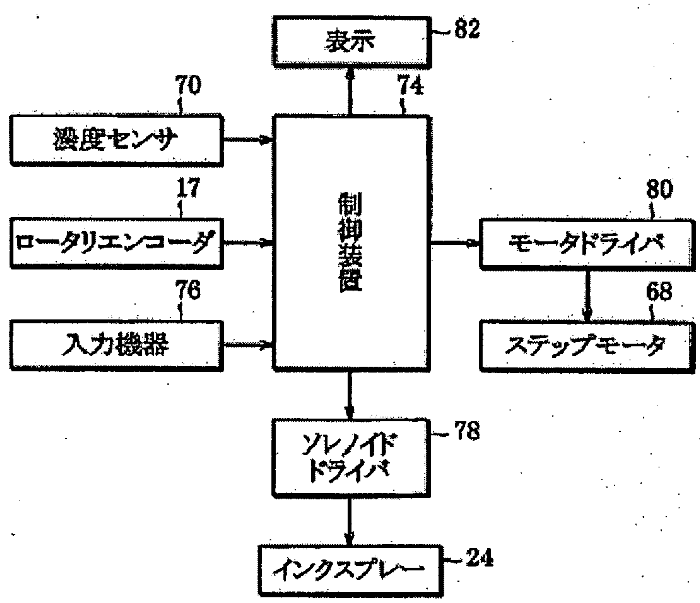

Figure 6

Key:

17	Rotary encoder
24	Ink sprayer
68	Step motor
70	Density sensor
74	Controller
76	Input equipment
78	Solenoid driver
80	Motor driver
82	Display

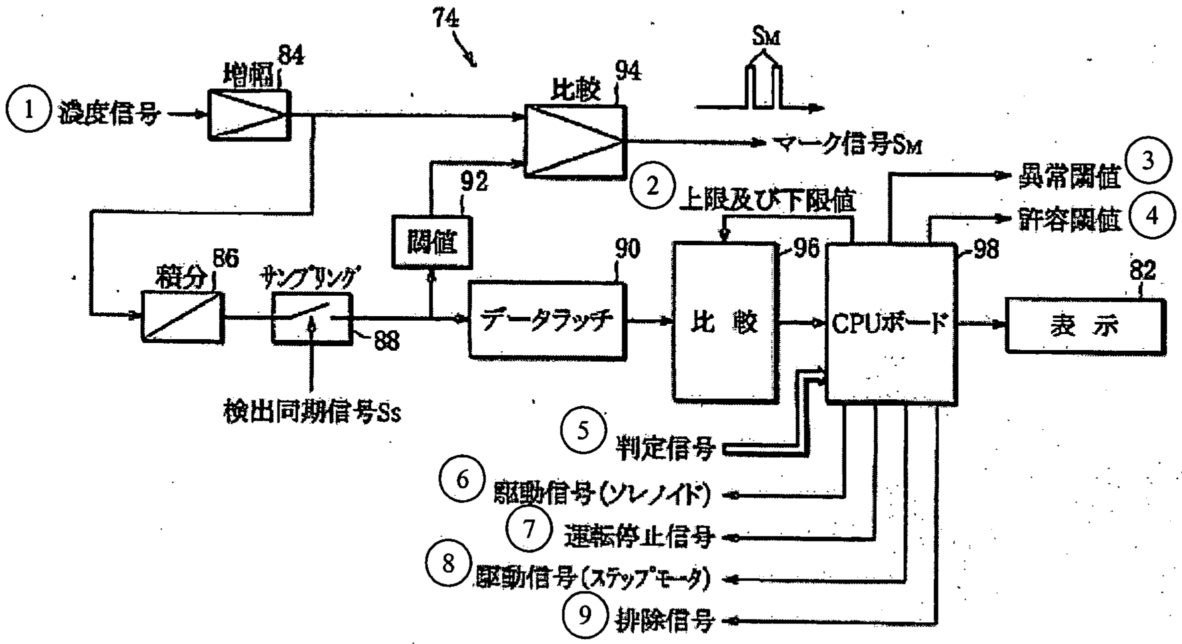

Figure 7

Key:	S_M	Mark signal
	S_S	Sensing synchronous signal
	1	Density signal
	2	Upper limit and lower limit
	3	Abnormal threshold value
	4	Permissible threshold value
	5	Judgment signal
	6	Drive signal (solenoid)
	7	Operation stop signal
	8	Drive signal (step motor)
	9	Exclude signal
	82	Display
	84	Amplification
	86	Integration
	88	Sampling
	90	Data latching
	92	Threshold value
	94	Comparison
	96	Comparison
	98	CPU board

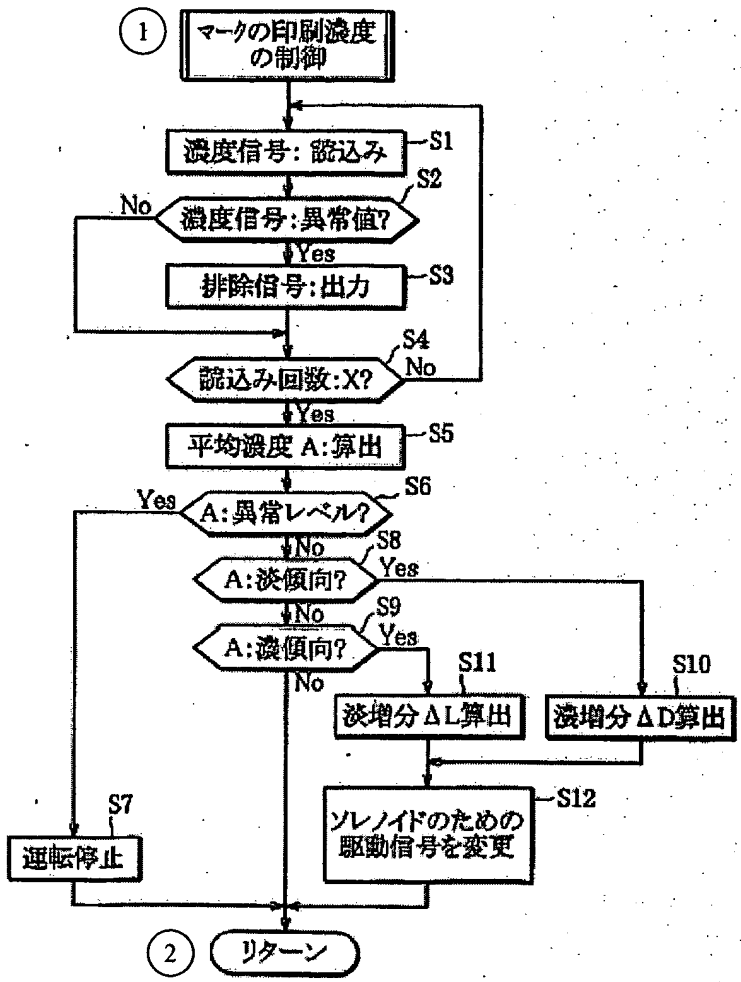

Figure 8

Key:

S1	Density signal: read
S2	Density signal: abnormal value?
S3	Exclude signal: output
S4	Number of times read: X?
S5	Average density A: calculate
S6	A: abnormal level?
S7	Stop operation
S8	A: light tendency?
S9	A: dark tendency?
S10	Dark increment ΔD calculation
S11	Light increment ΔL calculation
S12	Change drive signal for solenoid
1	Control of mark print density
2	Return

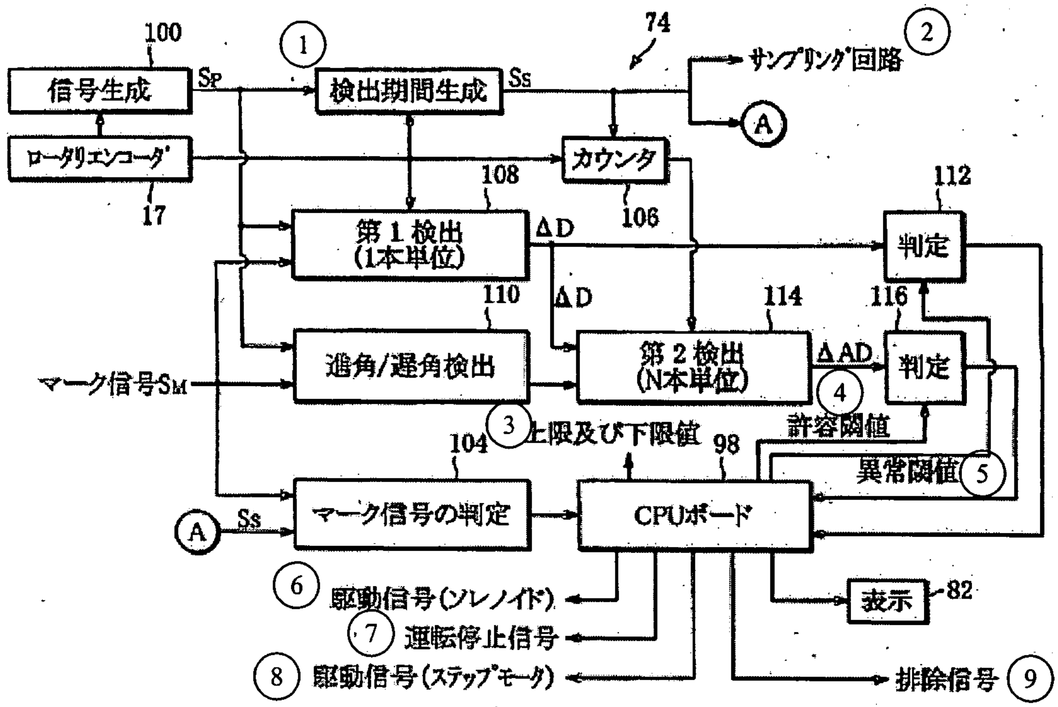

Figure 9

Key:	S_M	Mark signal
	1	Sensing period generation
	2	Sampling circuit
	3	Upper limit and lower limit values
	4	Permissible threshold value
	5	Abnormal threshold value
	6	Drive signal (solenoid)
	7	Operation stop signal
	8	Drive signal (step motor)
	9	Exclude signal
	17	Rotary encoder
	82	Display
	98	CPU board
	100	Signal generation
	104	Mark signal judgment
	106	Counter
	108	First sensing (unit of 1)
	110	Advance angle/lag angle sensing
	112, 116	Judgment
	114	Second sensing (units of N)

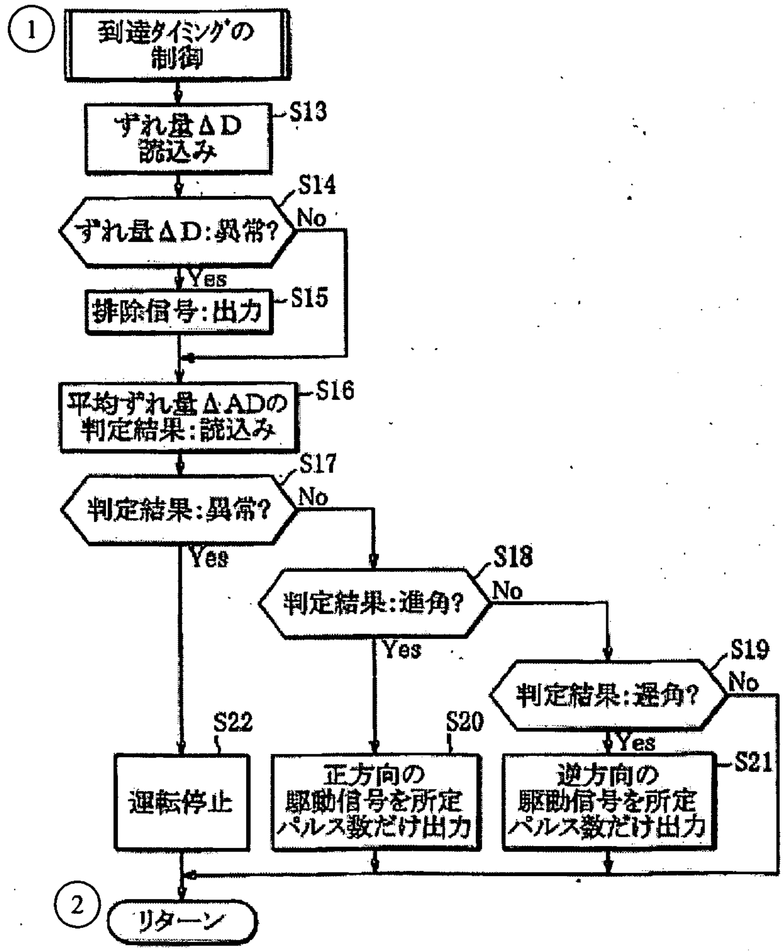

Figure 10

Key:
- S13 Read amount of divergence ΔD
- S14 Amount of divergence ΔD: abnormal?
- S15 Exclude signal: output
- S16 Judgment result for average amount of divergence ΔAD: read
- S17 Judgment result: abnormal?
- S18 Judgment result: advance angle?
- S19 Judgment result: lag angle?
- S20 Output drive signal for forward direction for prescribed number of pulses
- S21 Output drive signal for reverse direction for prescribed number of pulses
- S22 Stop operation
- 1 Control of arrival timing
- 2 Return

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/03018

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^7 A24C5/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl^7 A24C5/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 5-227938 A (Japan Tobacco Inc.), 07 September, 1993 (07.09.93), Full text (Family: none)	1-2 3-9
Y	JP 2001-275641 A (Japan Tobacco Inc.), 09 October, 2001 (09.10.01), (Family: none)	3-9
A	JP 62-83880 A (Japan Tobacco Inc.), 17 April, 1987 (17.04.87), (Family: none)	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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